UNIVERSIDADE
LUSÓFONA

Aplicação móvel para rastreio de Hepatite C

Final Report

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Direitos de cópia

Resumo

Este documento descreve as funcionalidades e as metodologias de uma aplicação móvel desenvolvida em colaboração com a Associação Ares do Pinhal, uma instituição de solidariedade social fundada em 1986 e dedicada a ajudar pessoas com dependências. Através de comunidades, programas de redução de danos e centros de acolhimento de emergência, a Ares do Pinhal dá prioridade aos cuidados integrais e à reintegração social.

Esta aplicação móvel, orientada ao acompanhamento do tratamento da hepatite C, em particular para pessoas com antecedentes de toxicodependência, visa garantir a adesão ao tratamento, a precisão dos cuidados e o acompanhamento do doente. Utilizando metodologias centradas em dados, a aplicação gere os dados dos doentes de forma eficaz e ajuda os prestadores de cuidados de saúde a apoiar as pessoas em tratamento da hepatite C.

Abstract

This document describes the functionality and methodology of a mobile application developed in collaboration with the Ares do Pinhal Association, a social solidarity institution founded in 1986 and dedicated to helping people with addictions. Through therapeutic communities, harm reduction programmes and emergency reception centers, Ares do Pinhal prioritizes comprehensive care and socio-professional reintegration.

This mobile application, which focuses on tracking hepatitis C treatment, particularly for people with an addiction background, aims to ensure treatment adherence, precision in care and thorough tracking of patient progress. Using data-centric methodologies, the app effectively manages patient data and helps healthcare providers to support people undergoing hepatitis C treatment.

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1. Problem Identification

The Ares do Pinhal Association has been at the forefront of addiction care in Portugal, implementing innovative treatment methods since its foundation in 1986. With a progressive approach encompassing various programmes and interventions, this institution has played a key role in mitigating the effects of drug abuse. However, challenges remain in ensuring treatment adherence among people with a history of drug dependence:

1.1. Challenges

Adherence Challenges Due to History of Substance Dependence: Patients with a history of drug addiction often face barriers to adherence to hepatitis C treatment plans. The complexities of addiction have a significant impact on their ability to adhere to treatment regimens.

Lack of Treatment Registry: There is a gap in the collection and monitoring of data on hepatitis C treatment in the community. This prevents effective monitoring and assessment of treatment adherence.

Hepatitis C is a treatable disease, and adherence to prescribed treatments can significantly impact patient outcomes and potentially save lives. Addressing these challenges requires a solution that aligns with the initiatives of Ares do Pinhal.

1.2. Current Treatment Monitoring Process

Currently, the treatment monitoring process at Ares do Pinhal involves manual recording on paper sheets. This method presents several drawbacks, including the risk of data loss, inaccuracies, and difficulties in tracking patient adherence over time.

1.2.1. Manual Treatment Monitoring Sheet

The current process requires healthcare professionals to manually fill out treatment monitoring sheets for each patient. These sheets typically include information such as:

Patient identification details

Dates and times of medication administration

Dosage information

Observations and notes from healthcare providers

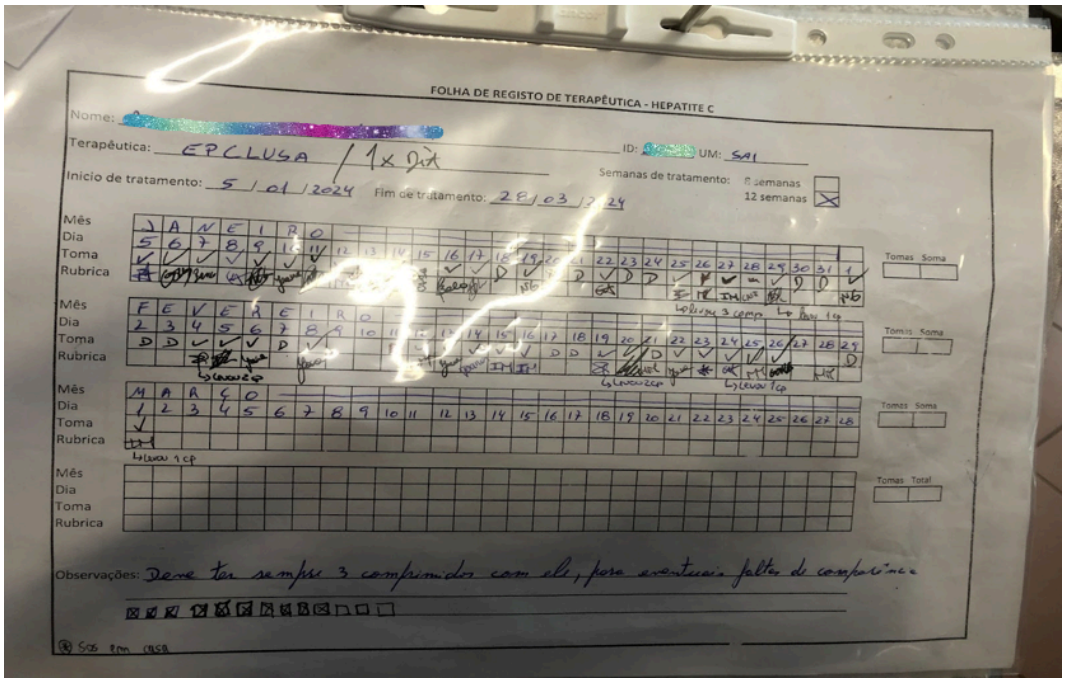


Figure 1 -

1.2.2. Drawbacks of the Manual Process

Data Loss: Paper records are susceptible to being lost, damaged, or misplaced, leading to gaps in patient treatment history.

Inaccuracies: Manual entry increases the risk of errors, such as incorrect dosage recording or missed entries.

Tracking Difficulties: Monitoring adherence over time is challenging without a centralized, easily accessible record system. This makes it difficult to identify patterns of non-adherence and intervene appropriately.

1.3. Need for an Improved Solution

To address these challenges, there is a need for an improved solution that can:

Streamline Data Collection and Monitoring: A digital platform can facilitate accurate and timely recording of treatment data, reducing the risk of errors and data loss.

Enhance Adherence Tracking: Automated reminders and alerts can help patients adhere to their treatment regimens, while analytics can help healthcare providers identify and address adherence issues promptly.

Integrate with Existing Initiatives: The solution should be designed to complement the existing programs and interventions of Ares do Pinhal, ensuring seamless integration and enhancing overall treatment outcomes.

By implementing a digital solution, Ares do Pinhal can significantly improve the monitoring and adherence of hepatitis C treatment among patients with a history of drug dependence, ultimately leading to better health outcomes and saving lives.

1 Feasibility and Relevance

2.1 Viability Assessment

Our assessment centers on carefully appraising the mobile application's practicality and effectiveness in real-world scenarios. This is underpinned by a formal agreement, jointly supported by Ares do Pinhal and Universidade Lusófona, ensuring access to the association's database. This collaboration solidifies the application's viability, affirming its practicality and pertinence in addressing tangible challenges.

2.2 Practicality and Mobile Platform Benefits

Integrating this application onto a mobile platform enhances its usability and enables real-time monitoring. The compatibility with mobile devices improves its relevance, offering greater flexibility and convenience in monitoring and managing treatments.

The benefits of mobile devices and apps to healthcare professionals are substantial. They enable faster decision-making with fewer errors, enhance data management and accessibility, and boost practice efficiency and knowledge. Notably, these benefits have a favorable impact on patient care outcomes by reducing negative events and hospital admissions. The utility of mobile devices, which facilitate evidence-based medicine at the point of care, improves clinical decision-making, documentation accuracy, efficiency, productivity, and workflow patterns for healthcare professionals. [MOBAP]

3 Benchmarking

A-CHESS (Addiction-Comprehensive Health Enhancement Support System) is a mobile health system designed to support addiction recovery and improve Hepatitis C Virus (HCV) care. It offers a variety of tools, including instant assistance requests, customized coping support, informative resources on addiction and infectious ailments, private messaging for guidance, and supervised peer discussions. It also delivers thorough participant assessments, routine check-ins, and customized surveys to track health progress and medication adherence. A-CHESS aims to fully address the complex needs of individuals in addiction recovery while enhancing HCV care and health outcomes【AHEPC】.

Features of A-CHESS:

Communication & Engagement:

- Offers private messaging for personalized guidance.
- Provides discussion boards for peer-based education.

Educational Resources:

- Houses extensive educational content on HCV, HIV, and addiction.
- Facilitates engagement through automated notifications.

Functional Tools:

- Includes a Moderator Dashboard for staff to monitor and message.
- Conducts baseline assessments and periodic interviews.

Our Application:

User Access:

- Provides secure login for technical users.
- Enables patient search using ID or name.
- Displays comprehensive patient information such as name, ID, age, etc.

Screening & Diagnosis:

- Records screening history and new screenings.
- Allows transition from testing to treatment.
- Manages treatment details, including medications and dates.

Comparative Insights:

User Engagement & Monitoring:

- **A-CHESS:** Features extensive automated engagement tools.
- **Our App:** Focuses on engagement and monitoring participant progress with a personalized approach tailored to the requirements of AdP.

Functional Advantages:

- **A-CHESS:** Broader selection of educational resources and tools for user engagement.
- **Our App:** Specific functionalities requested by AdP, such as detailed screening and diagnosis records, tailored to the needs of healthcare professionals working directly with the target population.

Cost Considerations:

- **A-CHESS:** May require subscription fees, making it less accessible to some users.
- **Our App:** Free to use, ensuring accessibility to all healthcare professionals and patients involved with AdP.

Alignment with User Needs:

- Our application was developed based on direct feedback from AdP, ensuring that it addresses the specific requirements of the association. This alignment ensures that our app includes essential features that may not be available in A-CHESS, providing a tailored solution for AdP's unique context.

Conclusion:

- While A-CHESS offers a broad range of features and resources, our application stands out for its tailored functionalities and cost-free accessibility. The direct involvement of AdP in the development process ensures that our app meets the specific needs of its users, reinforcing our commitment to providing effective and user-centered solutions. The similarities with A-CHESS validate our design approach, demonstrating our effort to integrate proven strategies while addressing the unique needs of AdP.

Overall, the resonance of our app with A-CHESS serves as an indication of our thoughtful design approach, highlighting our dedication to incorporating effective functionalities into our platform to support hepatitis C treatment and addiction recovery.

4 Engineering

4.1 Requirements gathering and analysis

Functional Requirements:

Requirement ID	Priority	Difficulty	Description
FR1	High	Medium	Implement a secure login mechanism for technical users (técnico) to access the application.
FR2	Medium	Low	Provide a search functionality for users by ID or name, displaying a list of users for technician selection.
FR3	High	Medium	Show comprehensive user details, including full name, date of birth, date of entry into the last program, patient ID (CC or passport), and age.
FR4	High	Medium	Display a history of screenings, including test date, test type, test location, result, and result date.
FR5	Medium	Medium	Allow technicians to input new screening details, including test date, test type, test location, result, and result date.
FR6	Medium	Medium	Allow technicians to edit current screening details, including test date, test type, test location, result, and result date.
FR7	High	Medium	Display a history of diagnosis, including test date, test type, test location, result, and result date.

FR8	Medium	Medium	Allow technicians to input new diagnosis details, including test date, test type, test location, result, and result date.
FR9	Medium	Medium	Allow technicians to edit current diagnosis details, including test date, test type, test location, result, and result date.
FR10	High	Medium	Support input fields for treatment start date, eligibility for treatment, medication name selection, next treatment date, expected treatment end date, actual treatment end date, notes/observations, and treatment end analysis.
FR11	High	Medium	Support input fields for new treatment entry with details as specified in FR10.
FR12	High	Medium	Support editing the fields for current treatment details as specified in FR10.
FR13	Medium	High	Ensure the app is scalable and supports integration with the existing systems of the Ares do Pinhal Association. This involves compatibility checks, data interoperability, and streamlined processes for collaboration.
FR14	Medium	Medium	Implement a feature to export data to a file, preferably in Excel format, to facilitate data analysis and reporting.
FR15	Low	Medium	Optionally provide access to all screens from a menu available on every page for user convenience.
FR16	High	Medium	Support the daily registration of medicine intake for patients, including whether the medicine was taken, if it was taken at home and any relevant notes..

FR17	Medium	High	Implement a calendar feature that allows healthcare professionals to access and edit daily medicine records by clicking on the specific day. This feature should facilitate easy navigation and modification of medicine intake records.

Non-Functional Requirements:

Requirement ID	Priority	Difficulty	Description
NFR1	High	Low	The application should have an intuitive and user-friendly interface to ensure ease of use for healthcare professionals.
NFR2	High	High	Implement robust security measures, especially during user login and data transmission, to safeguard patient information and comply with privacy guidelines.
NFR3	High	High	Ensure the application is scalable to handle integration with the association's systems and support additional features for patient treatment.
NFR4	High	Medium	The application should operate reliably, minimizing downtime and ensuring consistent access to critical information.
NFR5	Medium	Medium	Optimize the performance of the application, particularly in handling data retrieval, to provide a seamless user experience.
NFR6	High	Medium	Ensure interoperability with different systems and technologies, supporting the integration requirements with the association's existing systems.

4.2 Use Case Diagrams and description of application scenarios

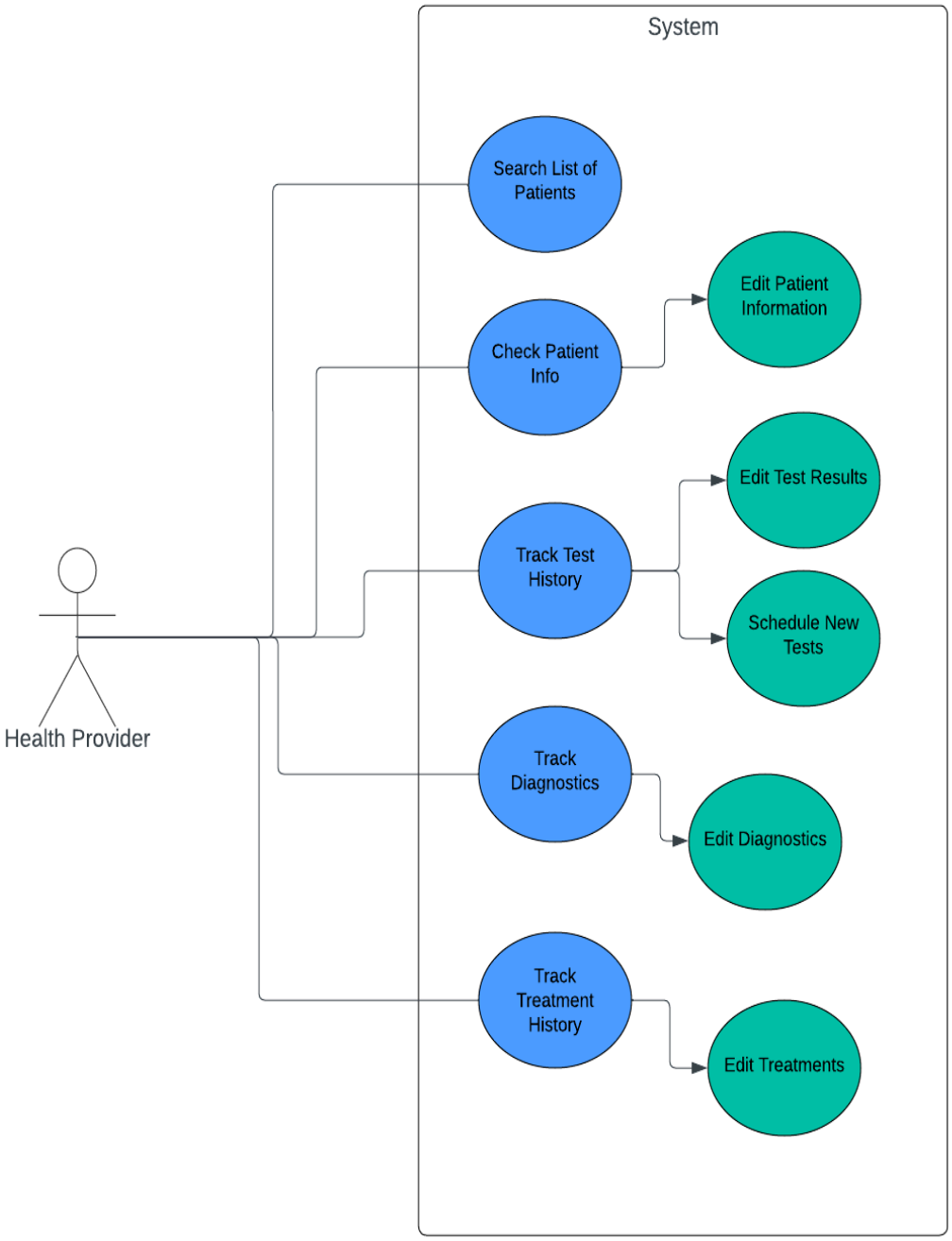


Figure 1 - Use Case Diagram

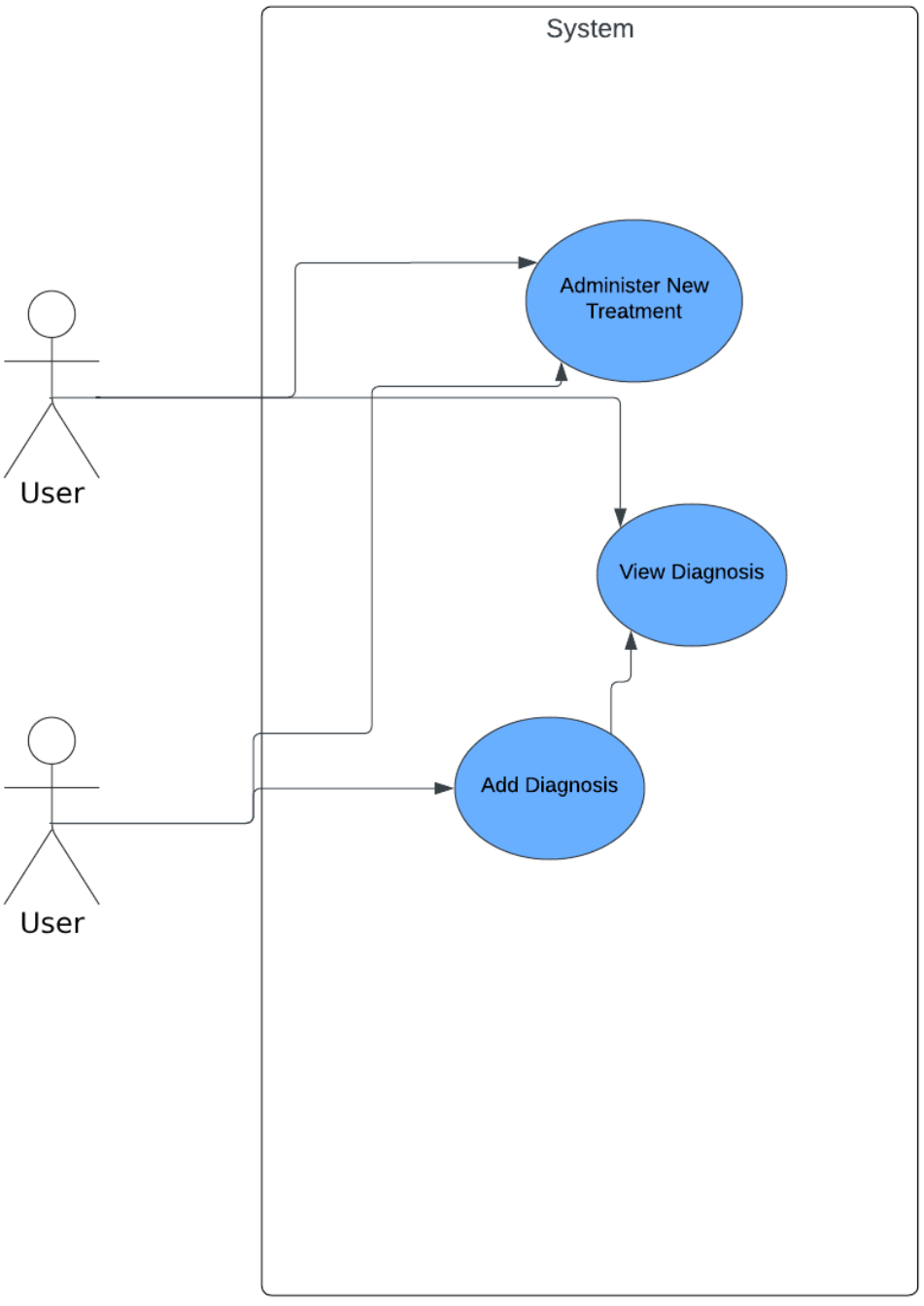


Figure 2 - Use Case Diagram

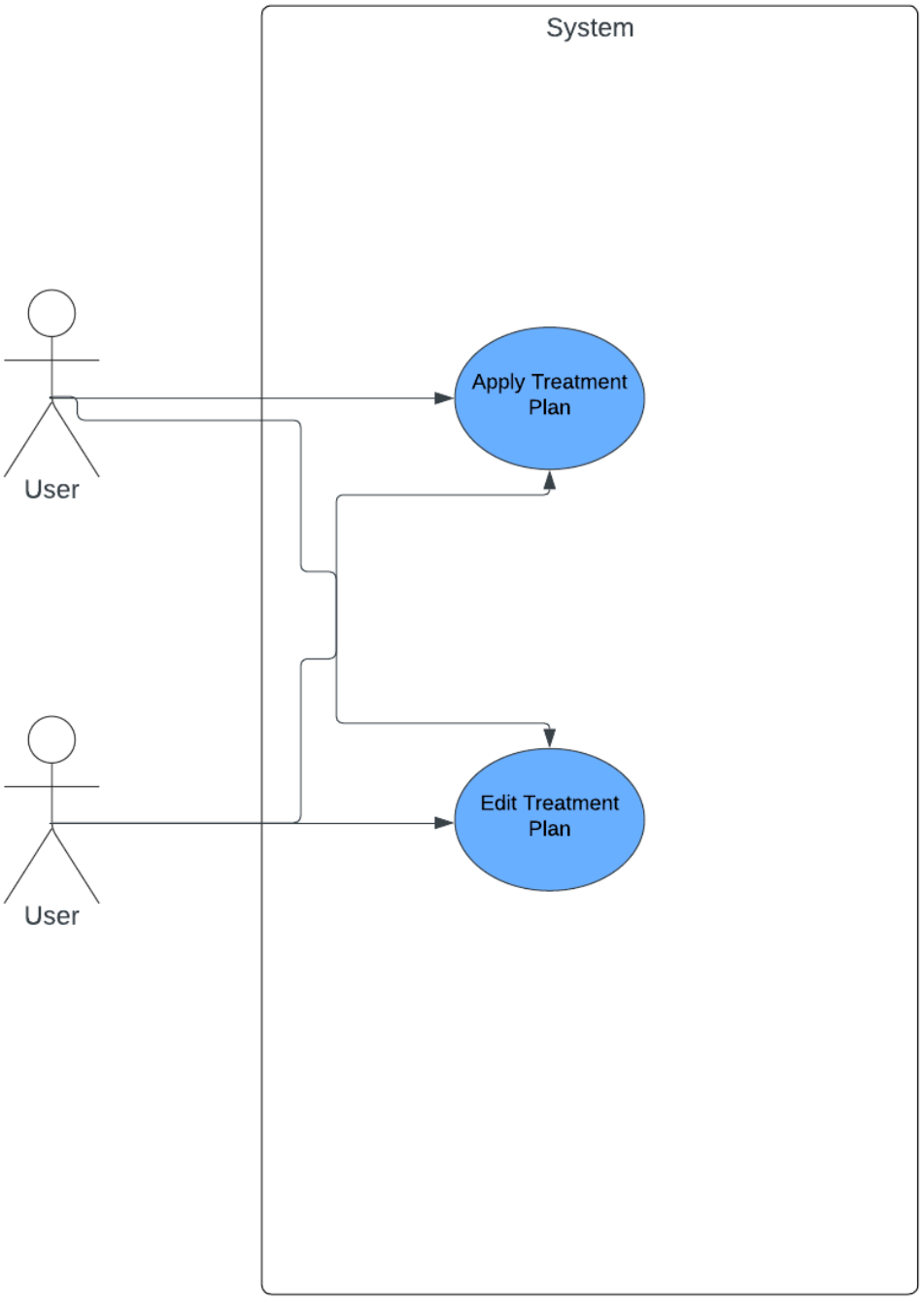


Figure 3 - Use Case Diagram

4.3 Activity Diagrams

Activity diagrams illustrate the sequence of activities, decision points and interactions between different components, providing a clear and structured view of the dynamic aspects of the system.

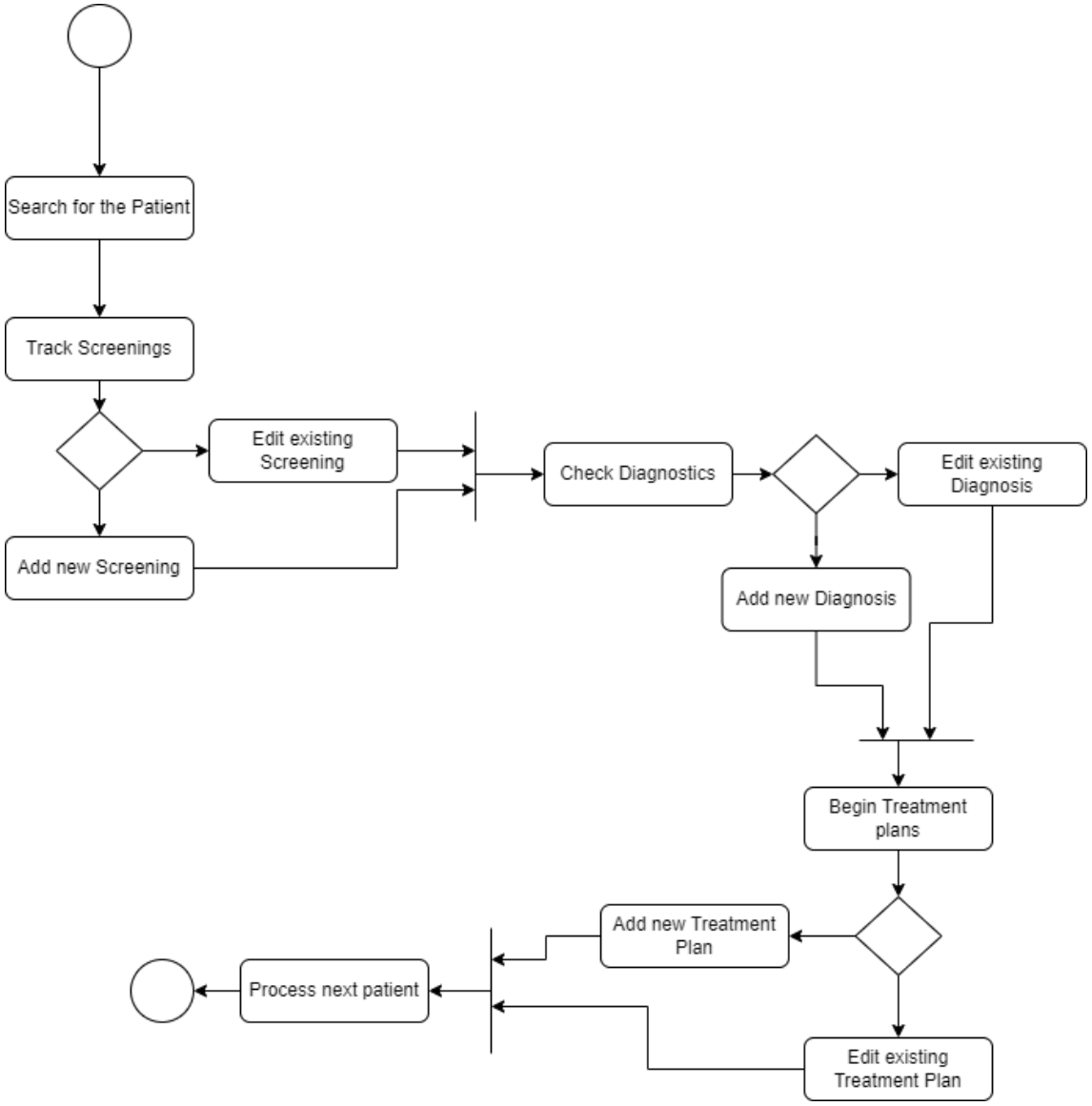


Figure 4 - Activity Diagram

4.4 Relevant models

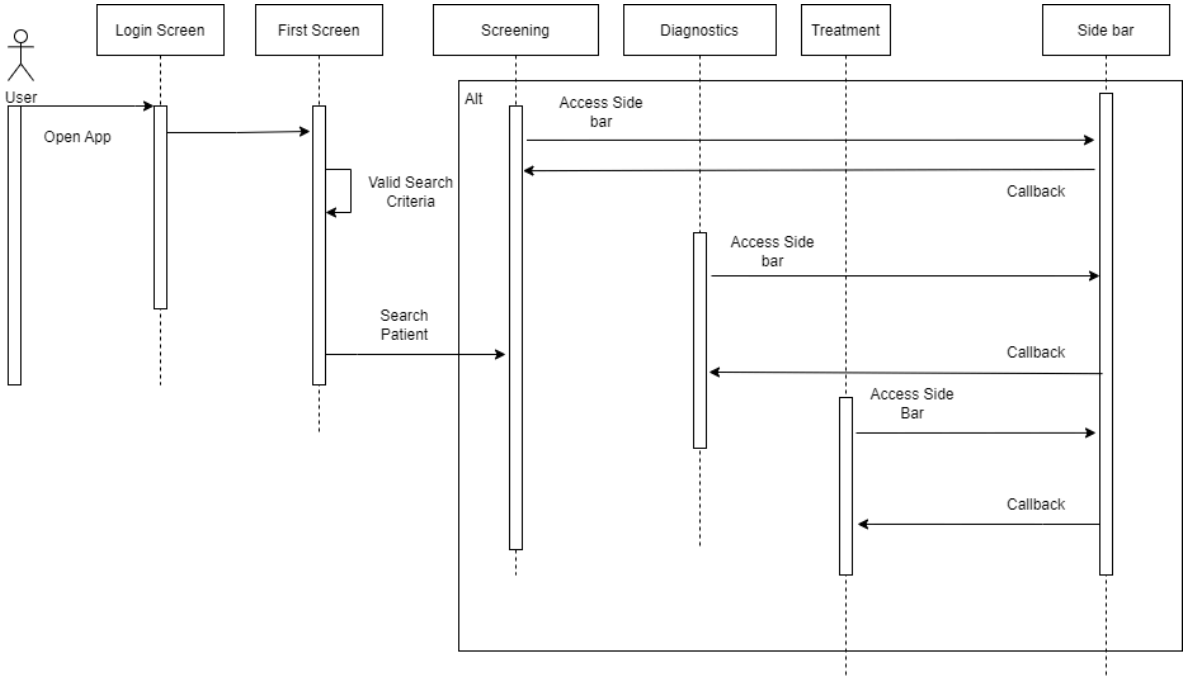


Figure 5 - Sequence Diagram

4.5 Structure

This sitemap structure visually represents how users can navigate through the website. It's a useful tool to understand the site's architecture and ensure a logical and user-friendly flow.

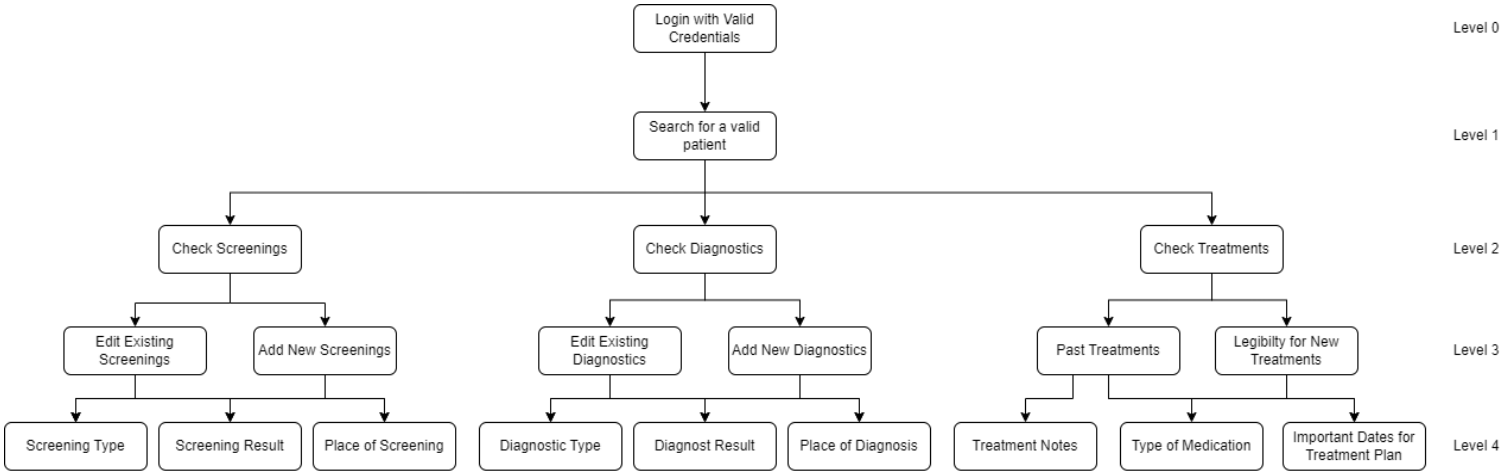


Figure 6 - Site Map

4.6 Mockups

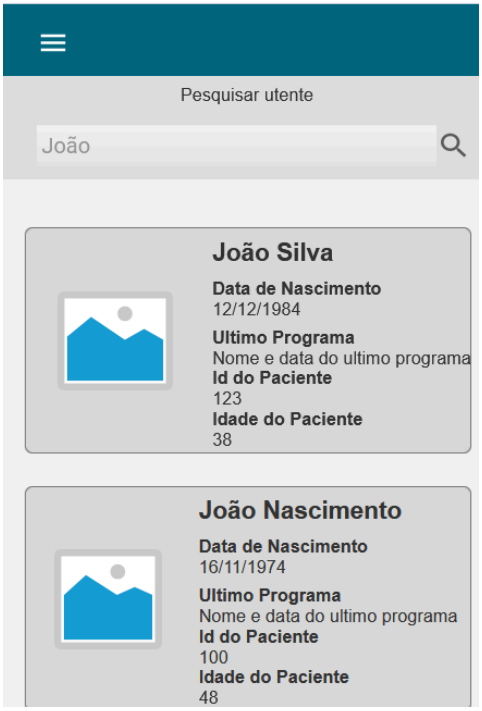


Figure 7 - Patient Selection Screen

This section allows user search by ID or name, presenting a list of patients with matching names for the technician's selection. Additionally, it provides patient details including full name, date of birth, entry date into the last ADP program, patient ID, and age.

Figure 8 - Screenings Screen

After patient selection, the app navigates to a page displaying the screening history, offering the option to add a new screening.

On the diagnostics page the healthcare professional using the application will be able to update what type of test was given to the specific person, the day of, the result, the day the result was received, and where the test was located.

Figure 9 - Diagnosis Screen

The Treatment page outlines the patient's eligibility for specific treatments and the prescribed medication. It tracks the treatment's start and expected end dates, allowing updates if treatment duration changes. Additionally, it enables professionals to note reasons if the patient discontinues the treatment plan.

Figure 10 - Treatments Screen

Access to patient information and navigation to other screens is facilitated by the side menu accessible on the diagnosis, screening and treatment pages.

Figure 11 - Side Menu

At the moment the mock-up is still under development and not all features are implemented or shown in this document. For an insight into the development of the mock-up, please use the following link: Mock-Up

5 Proposed Solution

5.1 Introduction

The development of a mobile application for Hepatitis C treatment monitoring offers a promising solution to challenges faced by the Ares do Pinhal Association:

Treatment Monitoring: Systematically recording and monitoring hepatitis C treatment to facilitate comprehensive patient care.

Accessible Interface: Featuring an intuitive design, influenced by "Human-Machine Interaction" and "Software Engineering," to enhance efficiency in data management for healthcare professionals.

Collaboration with Existing Systems: Striving for compatibility and integration with the association's systems, drawing insights from "Databases" for optimized collaboration.

Mobile Platform Advantage: increasing the accessibility, allowing healthcare providers to access patient information anytime, anywhere.

5.2 Architecture

5.2.1. General Architecture

The architecture emphasizes simplicity and efficiency, focusing on the following components:

- **Frontend (Flutter):** Utilizing Flutter for the user interface ensures a consistent and user-friendly experience across both iOS and Android devices. Flutter's single codebase approach allows for rapid development and maintenance.

- **Backend:**

  Kotlin: Kotlin is a modern programming language that offers conciseness, safety, and interoperability with Java. It reduces boilerplate code, making the development process faster and less error-prone. Kotlin's null safety features help in preventing common null pointer exceptions, enhancing the application's reliability.

  Spring Framework: Spring provides a comprehensive programming and configuration model for modern Java-based enterprise applications. Its support for dependency injection promotes loose coupling and enhances testability. The Spring ecosystem, including Spring Boot, simplifies the development of robust and scalable backend services.

- **Our Database (MySQL):** Our backend stores data in a MySQL database, which supports efficient data management.

5.2.2. Security

Data security, especially during login, is prioritized with practical measures:

- Authentication and Authorization API: A secure API endpoint manages user authentication and authorization, limiting access to authorized personnel.

- Secure Communication: Encryption protocols are implemented to secure all communications, safeguarding against potential security threats during login.

  Additionally, to ensure the utmost security of patient information, the use of a Virtual Private Network (VPN) is mandated when accessing the application. This requirement adds an extra layer of encryption and protection, aligning with the app's commitment to maintaining the confidentiality and integrity of sensitive healthcare data.
  During testing phases, the use of a VPN is not necessary.

5.3 Technologies and Tools Used

This section outlines the necessary technologies and tools required for the successful implementation of the proposed solution.

Axure RP: It streamlines design and prototyping with its robust features for high-fidelity wireframes and interactive prototypes. It facilitates collaborative design processes, aiding in visualizing user interactions and app structures. We're utilizing Axure to create detailed blueprints and realistic previews, while incorporating the teachings from “Human-Machine Interaction” to ensure our designs meet user needs. As our project progresses, we'll continue leveraging Axure and exploring additional tools to enhance our user-centered approach.[AXD23]

Flutter: Chosen for its flexibility in creating user interfaces, it's based on a widget-driven framework that quickly creates and customizes interfaces while efficiently managing states [FLTD23]**.** Alongside Flutter, we're exploring additional technologies to extend its capabilities, with a focus on performance and advanced functionality. This combined approach aims to exceed user expectations and deliver a seamless and feature-rich mobile app experience.

Dart: will be the main programming language used for the development of our mobile application. It complements our use of the Flutter framework, with a focus on optimized performance for mobile applications. Its clean syntax and support for object-oriented programming will contribute to the efficiency of our codebase.[DART23]

MySQL: is chosen as the database management system for its efficiency in storage and retrieval, ensuring data integrity, scalability, and robustness. This relational database supports complex queries and transactions, meeting the application's data management needs.

5.4 Implementation

Implemented Features

The following section showcases the key features and functionalities that have been implemented in our mobile application, along with corresponding backend web services.

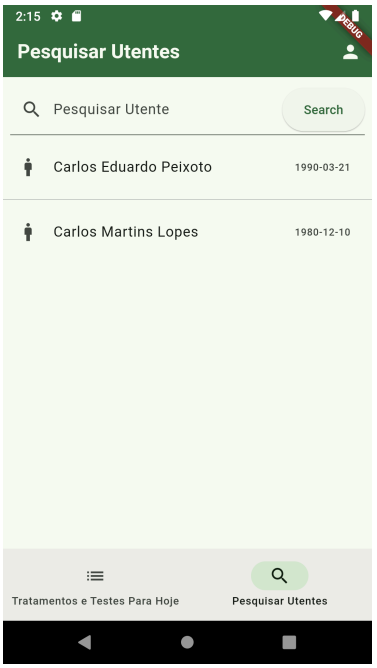
Screenshots of the Application

Here are some screenshots illustrating the user interface and functionality of the mobile application:

1. **Login Screen:**

2. **Daily Treatments and Tests Page:**

3. **Search Patient:**



4. **Patient Information Page:**

Backend Web Services

The backend web services have been implemented to support the functionality of the mobile application. Below is a brief description of the key web services:

1. **User Authentication Service**
    - **Endpoint:** `/api/validateCredentials`
    - **Method:** GET
    - **Description:** Validates user credentials.

Daily Medicine Service

- **Endpoint:** `/api/dailyMedicine`
- **Methods:** POST, GET
- **Description:**
    - **POST:** Registers a new daily medicine entry.
    - **GET:** Retrieves daily medicine records.

Patient Information Service

- **Endpoint:** `/api/patient`
- **Methods:** GET
- **Description:** Retrieves patient details and lists patients based on various criteria.

1.

2. **Treatment History Service**
    - **Endpoint:** `/api/treatment-history`
    - **Method:** GET
    - **Description:** Fetches the treatment history of a patient.
3. **Diagnosis History Service**
    - **Endpoint:** `/api/diagnosis-history`
    - **Method:** GET
    - **Description:** Fetches the diagnosis history of a patient.

These services are developed using Kotlin and Spring Boot, ensuring a robust and scalable backend that efficiently supports the application's needs. The database interactions are handled via MySQL, ensuring reliable and efficient data management.

By providing a secure, responsive, and user-friendly mobile application, we aim to improve the management and tracking of Hepatitis C treatment, delivering a valuable tool for healthcare professionals and patients alike.

5.5 Scope

5.5.1 Target Users

The application is tailored for healthcare professionals responsible for monitoring patients undergoing Hepatitis C treatment, with a specific focus on those with a history of substance dependence. Drawing insights from "Human-Machine Interaction," the user interface is designed to accommodate professionals with varying levels of technical expertise, ensuring ease of use in healthcare settings.

5.5.3 Integrating with Existing Systems

The project will study the integration of the application with the systems of the Ares do Pinhal Association, drawing on knowledge from "Databases", "Distributed Computing" and "Algorithms and Data Structures" courses. By using principles from these courses, the project aims to achieve smooth integration, enhanced data interoperability and improved healthcare processes.

If integration is not feasible, the architecture will support autonomous operation with an internal database, ensuring functionality in diverse technological landscapes.

5.5.4 Ethical and Privacy Considerations

The project prioritizes ethical considerations related to patient data handling. Robust security measures will be implemented to safeguard patient information, ensuring compliance with regulatory standards and privacy guidelines.These practices aim to maintain the confidentiality and integrity of sensitive healthcare data.

Moreover, to enhance the privacy and security of patient data, the usage of a Virtual Private Network (VPN) is mandatory when interacting with the application. This additional requirement contributes to the secure transmission and protection of patient information, aligning with the project's commitment to ethical and privacy considerations in healthcare data management.

5.5.6 Continuous Evaluation

The project scope, influenced by principles from "Software Engineering" and "Human-Machine Interaction," includes mechanisms for continuous evaluation. By collecting user feedback and employing an iterative approach, the application will evolve according to the changing needs of healthcare professionals. This feedback-centric strategy aims to enhance the effectiveness and contribution of the application to the monitoring of Hepatitis C treatment.

5.5.7 Advantage of a mobile platform:

Employing the concepts taught in “Mobile Computing” helps us work as effectively as possible in a mobile application. The use of a mobile platform offers unparalleled accessibility and flexibility. Healthcare providers can conveniently access patient information and update treatment progress anytime, anywhere, significantly improving continuity of care and responsiveness to patient needs.

6 Testing Plan and Validation

The TFC will be developed according to a work plan that provides effective guidance for project management. The following tasks are detailed for this project phase, along with high-level estimates for subsequent work. The purpose of these estimates is to predict the characteristics of the deliverables so that comprehensive assessments can be made to verify that the objectives have been met.

Current Project Phase:

The project is currently in the phase where some tasks have already been completed, such as the majority of the requirements analysis, functional and non-functional, and the elaboration of the mockup. Although progress has not met expectations between the last report and the current one, I am confident that we can overcome the setbacks in the requirements gathering phase.

Challenges Encountered:

The main difficulty that impacted progress was related to requirements gathering, setbacks in this process affected the previously proposed schedule.

The modifications in requirements are crucial to allow for the possible integration with the existing systems of the Ares do Pinhal Association. These adjustments are necessary to ensure compatibility, data interoperability and streamlined processes.

Figure 12 - Gantt Chart

Test Plan and Validation

The Test Plan and Validation section outlines the processes and methods used to ensure that the mobile application meets its functional and non-functional requirements, operates reliably, and provides a user-friendly experience. This section includes the following key components:

Test Objectives

The primary objectives of testing the mobile application are:

1. To verify that all functional requirements are correctly implemented.
2. To ensure the application is secure, reliable, and performs well under various conditions.
3. To validate the user experience, ensuring the application is intuitive and easy to use for healthcare professionals.

Test Scope

The testing scope covers all aspects of the application, including:

1. User Authentication
2. Patient Management (search, selection, and information display)
3. Screening and Diagnosis Management
4. Treatment Management
5. Calendar and Event Management
6. Data Export and Integration
7. User Interface and Usability
8. Performance and Security

Test Types

1. **Unit Testing**: Testing individual components or units of the application to ensure they work as expected.
2. **Integration Testing**: Verifying that different components of the application work together seamlessly.
3. **System Testing**: Testing the complete application to ensure it meets all specified requirements.
4. **User Acceptance Testing (UAT)**: Ensuring that the application meets the needs and expectations of end-users.
5. **Performance Testing**: Evaluating the application's performance under various conditions, including load testing and stress testing.
6. **Security Testing**: Assessing the application's security features to ensure data protection and compliance with privacy guidelines.

Test Environment

The testing will be conducted in a controlled environment that simulates real-world conditions. This includes:

1. **Devices**: Testing on various mobile devices (iOS and Android) with different screen sizes and resolutions.
2. **Operating Systems**: Ensuring compatibility with multiple versions of iOS and Android.
3. **Network Conditions**: Testing under different network conditions, including Wi-Fi, 4G, and 5G.

Test Plan

1. **Preparation Phase**:
    - Define test cases and scenarios based on functional and non-functional requirements.
    - Set up the test environment and tools.
    - Prepare test data.
2. **Execution Phase**:
    - Conduct unit testing on individual components.
    - Perform integration testing to ensure components work together.
    - Execute system testing to validate the entire application.
    - Carry out user acceptance testing with healthcare professionals.
    - Conduct performance and security testing.
3. **Reporting Phase**:
    - Document test results, including any defects or issues found.
    - Provide a summary of testing outcomes and recommendations for improvements.
    - Track and verify the resolution of reported issues.

Test Cases

Test cases will be created for each functional and non-functional requirement. Each test case will include:

1. **Test Case ID**: A unique identifier for the test case.
2. **Test Description**: A brief description of what the test case will validate.
3. **Preconditions**: Any conditions that must be met before executing the test.
4. **Test Steps**: Step-by-step instructions to execute the test.
5. **Expected Results**: The expected outcome of the test.
6. **Actual Results**: The actual outcome of the test (to be filled during execution).
7. **Status**: Pass/Fail status based on the comparison of expected and actual results.

Validation Criteria

The application will be considered validated if:

1. All high-priority functional requirements are fully met.
2. No critical or major defects remain unresolved.

3. The application performs well under various conditions.
4. The user experience meets the expectations of healthcare professionals.

By following this test plan and validation process, we aim to ensure that the mobile application for Hepatitis C treatment monitoring is reliable, secure, and user-friendly, ultimately supporting healthcare professionals in providing effective patient care.

7. Method and Planning

Current Project Phase

The project is currently nearing completion, with the majority of development tasks successfully executed. The app itself is almost fully developed, with only a few remaining requirements left to address.

While most of the core functionalities are in place, some additional features and refinements are still in progress. These include final adjustments to ensure compatibility and seamless integration with the existing systems of the Ares do Pinhal Association.

In addition, a thorough code cleanup is necessary to enhance the maintainability and readability of the application. This involves refactoring to improve code structure, removing redundant code, and ensuring adherence to best coding practices. Once these final steps are completed, the application will be ready for deployment and user acceptance testing.

Overall, the project has made substantial progress and is on track to deliver a fully functional and polished application.

Challenges Encountered

The main difficulty was the lack of a structured work methodology, which made planning and meeting objectives challenging. This absence led to significant setbacks in the requirements gathering process and affected the entire workflow. Additionally, it hindered the app development phase, complicating coordination and causing delays. Without a clear approach, adapting to changes and ensuring compatibility with the Ares do Pinhal Association's systems became difficult, resulting in increased complexity and extended timelines.

Adopting a structured methodology in future projects will be essential to improve planning, coordination, and timely achievement of objectives, facilitating better requirement management and smoother integration of changes.

Method of Work

- **Initial Phase**: Gathering requirements, both functional and non-functional, and defining the scope of the project.
- **Design Phase**: Creating detailed mockups and diagrams to visualize the application structure and flow.
- **Development Phase**: Implementing the application using Agile methodologies to ensure iterative progress and continuous feedback.
- **Testing Phase**: Conducting thorough testing to ensure the application meets all specified requirements and is free of critical defects.
- **Deployment Phase**: Preparing the application for deployment, ensuring all necessary documentation and training materials are in place.

Evolution and Adaptation

Throughout the year, the project evolved in terms of effort, concepts, objectives, and expected results. The initial vision was refined based on feedback and challenges encountered. This included:

- Adjusting the project timeline to accommodate changes in requirements.
- Revising objectives to align with the latest insights and stakeholder feedback.
- Implementing additional features based on new requirements and user feedback.
- Addressing technical challenges and optimizing the application for better performance and usability.

By documenting these changes and analyzing the overall project execution, we can ensure continuous improvement and alignment with the project goals.

8. Results

This section provides a detailed description of the project's results, outputs, and outcomes. The identification of results should be carried out in parallel with Chapter 2 of the report, analyzing the fulfillment of the success criteria determined during the requirements gathering, including any revisions made throughout the development of the project, supported by the results of the test cases defined in the 2nd intermediate report.

8.1 Comparison with Initial Requirements

Functional Requirements:

Requirement ID	Planned Requirement	Status
FR1	Implement a secure login mechanism for technical users (técnico) to access the application.	Fully achieved.
FR2	Provide a search functionality for users by ID or name, displaying a list of users for technician selection.	Fully achieved.
FR3	Show comprehensive user details, including full name, date of birth, date of entry into the last program, patient ID (CC or passport), and age.	Fully achieved.
FR4	Display a history of screenings, including test date, test type, test location, result, and result date.	Fully achieved.
FR5	Allow technicians to input new screening details, including test date, test type, test location, result, and result date.	Fully achieved.

FR6	Allow technicians to edit current screening details.	Deferred to future development.
FR7	Display a history of diagnosis, including test date, test type, test location, result, and result date.	Fully achieved.
FR8	Allow technicians to input new diagnosis details, including test date, test type, test location, result, and result date.	Fully achieved.
FR9	Allow technicians to edit current diagnosis details.	Deferred to future development.
FR10	Support input fields for treatment start date, eligibility for treatment, medication name selection, next treatment date, expected treatment end date, actual treatment end date, notes/observations, and treatment end analysis.	Fully achieved.
FR11	Support input fields for new treatment entry.	Fully achieved.
FR12	Support editing the fields for current treatment.	Deferred to future development.
FR13	Ensure the app is scalable and supports integration with the existing systems of the Ares do Pinhal Association.	Partial implementation.
FR14	Implement a feature to export data to a file, preferably in Excel format.	Deferred to future development.
FR15	Optionally provide access to all screens from a menu available on every page.	Successful

Non-Functional Requirements:

Requirement ID	Planned Requirement	Status
NFR1	The application should have an intuitive and user-friendly interface to ensure ease of use for healthcare professionals.	Fully achieved.
NFR2	Implement robust security measures, especially during user login and data transmission, to safeguard patient information and comply with privacy guidelines.	Fully achieved.
NFR3	Ensure the application is scalable to handle integration with the association's systems and support additional features for patient treatment.	Fully achieved.
NFR4	The application should operate reliably, minimizing downtime and ensuring consistent access to critical information.	Fully achieved.
NFR5	Optimize the performance of the application, particularly in handling data retrieval, to provide a seamless user experience.	Fully achieved.
NFR6	Ensure interoperability with different systems and technologies, supporting the integration requirements with the association's existing systems.	Further testing required.

8.2 Compliance with Success Criteria

The project's success criteria were largely met, with a few exceptions:

- **Implemented Requirements:** Most functional and non-functional requirements were successfully implemented and approved by the association.
- **Deferred Features:** Some features, such as editing current screenings and diagnoses, and data export functionality, were deferred to future development phases.

Overall, the project has achieved its primary objectives and provides a solid foundation for further enhancements.

8.3 Security and Privacy Measures

The application includes the following security features:

- **Authentication:** Secure login mechanisms ensure that only authorized users can access the application.
- **Access Control:** User roles and permissions are enforced to protect patient data.

Pending Implementation: VPN Requirement

A planned security measure, the mandatory use of a VPN, has not been implemented yet. The VPN would add an extra layer of security by encrypting all data transmission, especially on unsecured networks.

8.4 Impact and Benefits

The application is expected to have a significant positive impact on the target users:

- **Enhanced Data Management:** Healthcare professionals can efficiently manage patient data, leading to better patient outcomes. The mobile application centralizes patient information, reducing errors and streamlining data retrieval and analysis.
- **Accessibility:** The mobile platform allows for real-time access to patient information, improving the responsiveness and quality of care. Healthcare providers can update and review patient data anytime, anywhere, enhancing the continuity of care.

Current Daily Medicine Registration Process:

- **Daily Medicine Intake:** Currently, the daily intake of medicine is registered manually by healthcare professionals. This process is time-consuming and prone to errors, as it relies heavily on accurate and timely recording by the staff.

Benefits of Mobile App Approach:

- **Automation and Efficiency:** A mobile app approach automates the registration of daily medicine intake, reducing the workload on healthcare professionals and minimizing the risk of errors.
- **Real-Time Updates:** The app allows for instant updates, ensuring that patient records are always current. This real-time capability is crucial for timely interventions and adjustments to treatment plans.
- **Enhanced Monitoring:** With automated reminders and notifications, the app helps ensure that patients take their medications as prescribed, further improving adherence and outcomes.

9. Conclusion and Future Work

This section summarizes the project, its outcomes, and outlines potential future work to enhance the application.

9.1 Conclusion

The development of the mobile application for hepatitis C treatment tracking in collaboration with the Ares do Pinhal Association has achieved significant milestones. The application provides a secure, efficient, and user-friendly platform for healthcare professionals to monitor and manage patient treatment, improving adherence and patient outcomes. The implementation of various functionalities, including user authentication, patient data management, and treatment tracking, has been successful, with most planned requirements being met.

9.2 Future Work

While the application has met most of its base goals, several areas could be further developed and enhanced:

1. **VPN Implementation**: Completing the VPN implementation is a priority to enhance data security, especially during data transmission over unsecured networks.
2. **Feature Expansion**: Future development plans include adding analytics capabilities to track treatment progress more effectively. This will help healthcare professionals gain insights into patient outcomes and adjust treatment plans accordingly.
3. **Disease Extension**: Extending the application to cover other infectious diseases, such as HIV, is crucial given the high prevalence of co-infections in the target population. This expansion will allow for comprehensive monitoring and treatment of multiple conditions, improving overall patient health.
4. **User Feedback Integration**: Continuous collaboration with end-users is essential to ensure the application evolves according to their needs. Regular feedback sessions and updates will help refine the app and add features that enhance usability and effectiveness.
5. **System Integration**: Full integration with existing systems of the Ares do Pinhal Association will streamline workflows and ensure seamless data interoperability, further improving efficiency and care quality.

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JMIR Res Protoc 2019;8(8):e12620

URL: https://www.researchprotocols.org/2019/8/e12620

DOI: 10.2196/12620

Annex I

This segment encapsulates the activities detailed in the Gantt chart below, including User Registration, Interface Design, Testing, Debugging and Final Preparations for App Launch. The visual representation illustrates the comprehensive timeline and task distribution critical to the successful development and deployment of the app.

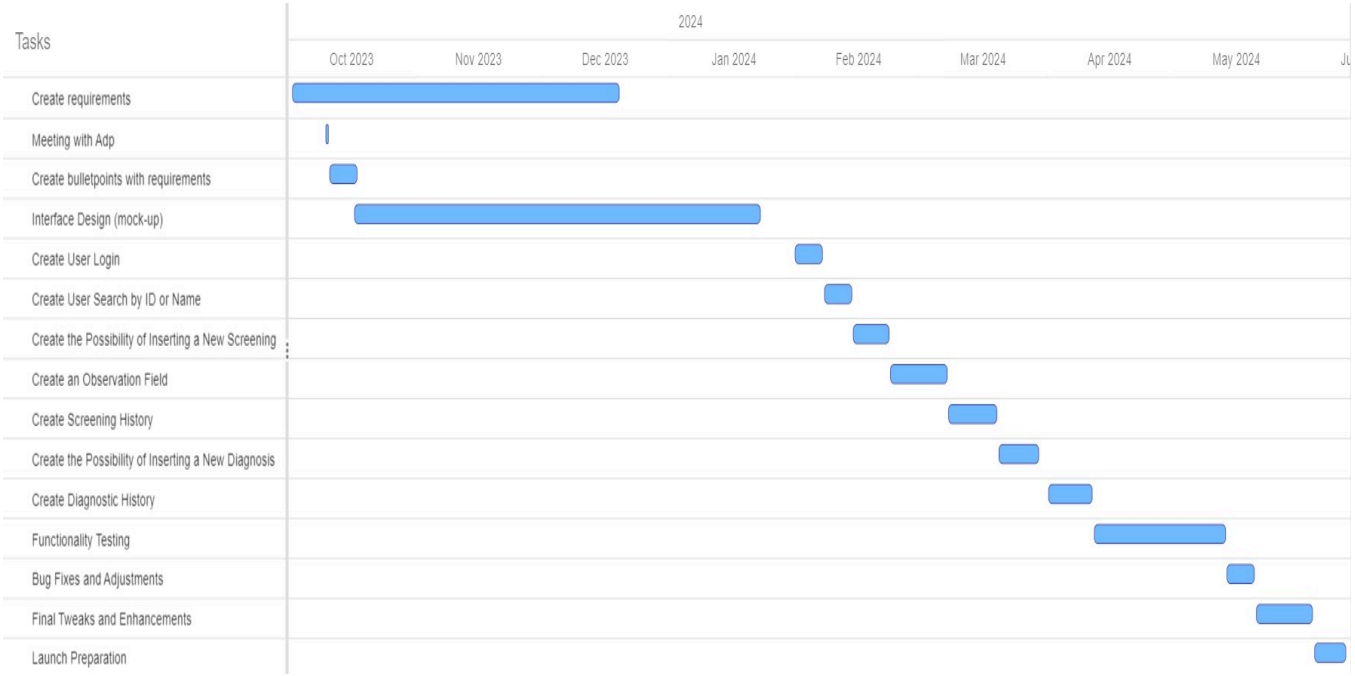

Figure 12 - Old Gantt Chart

Annex II

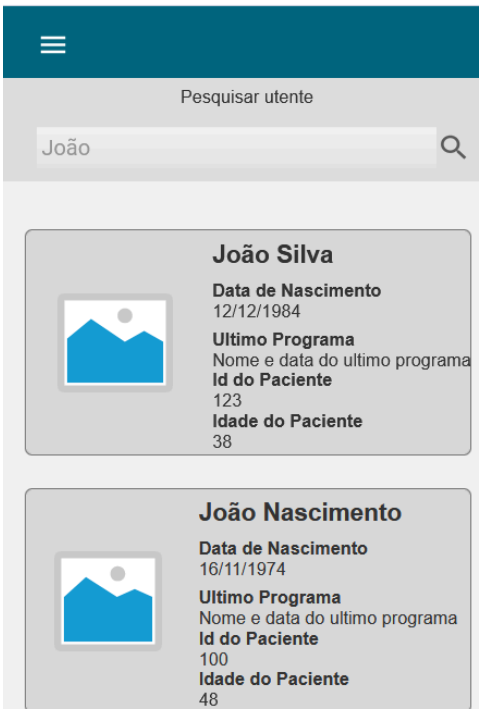

Figure 7 - Patient Selection Screen

This section allows user search by ID or name, presenting a list of patients with matching names for the technician's selection. Additionally, it provides patient details including full name, date of birth, entry date into the last ADP program, patient ID, and age.

After patient selection, the app navigates to a page displaying the screening history, offering the option to add a new screening.

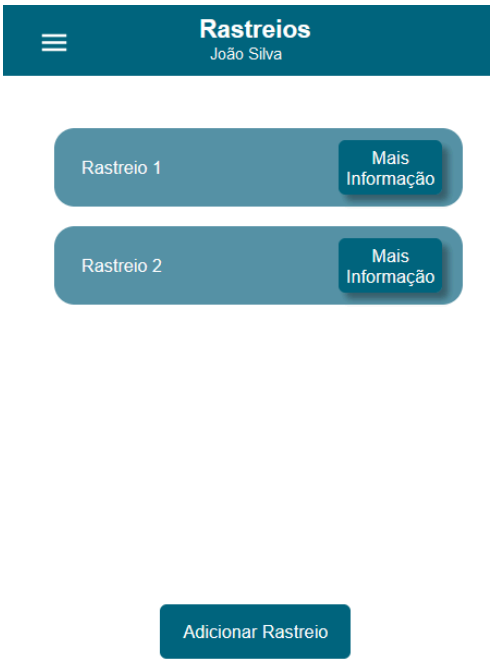

Figure 8 - Screenings Screen

On the diagnostics page the healthcare professional using the application will be able to update what type of test was given to the specific person, the day of, the result, the day the result was received, and where the test was located.

Figure 9 - Diagnosis Screen

The Treatment page outlines the patient's eligibility for specific treatments and the prescribed medication. It tracks the treatment's start and expected end dates, allowing updates if treatment duration changes. Additionally, it enables professionals to note reasons if the patient discontinues the treatment plan.

Figure 10 - Treatments Screen

Access to patient information and navigation to other screens is facilitated by the side menu accessible on the diagnosis, screening and treatment pages.

Figure 11 - Side Menu

At the moment the mock-up is still under development and not all features are implemented or shown in this document. For an insight into the development of the mock-up, please use the following link: Mock-Up

Glossary

LEI	Licenciatura em Engenharia Informática
TFC	Trabalho Final de Curso
ADP	Ares do Pinhal
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus